THE CATALPA MIDGE.

Cecidomyia catalpae Comstock.

OHIO
Agricultural Experiment Station.

WOOSTER, OHIO, U. S. A., OCTOBER, 1908.

BULLETIN 197.

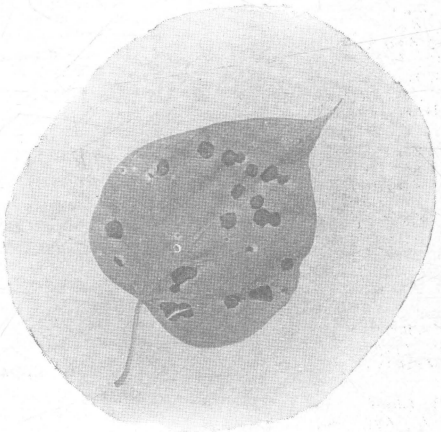

Photo by Goodwin.

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BULLETIN

OF THE

Ohio Agricultural Experiment Station

NUMBER 197. OCTOBER, 1908.

THE CATALPA MIDGE.

Cecidomyia catalpae Comstock.

BY H. A. GOSSARD.

CHARACTER OF DAMAGE AND IMPORTANCE.

Three distinct forms of injury are chargeable to the larvae of the catalpa midge.

1. To the leaves, causing a form of leaf spot.
2. To the terminal buds and ends of the branches.
3. To the seeds in the pods.

1. The adult midges must appear in late May and early June in ordinary seasons. About June 22, 1908, my assistants found injury pronounced on many trees and numerous larvae were in the terminal buds. A close examination of the material brought in from the field soon discovered larvae on the leaves as well as in the buds, and a few hours observation of hundreds of larvae on collected leaves, as well as on leaves still on the trees, established their connection with the leaf-spot trouble. In the center of many of the spots could be found a larva with its head end inserted into a small hole in the center of the spot from which it imbibed its nourishment. Apparently the damage was caused by the removal of the plant juices from the spot, as there seemed to be no separation of the upper and lower epidermal surfaces over the injured area, nor did the larva seem to bury the front part of its body between the surfaces after the manner of some leaf-miners. Some spots just commencing to form could be found with young larvae feeding in their centers. Hundreds of these spots could often be found on single leaves, and large fruiting trees are sometimes so badly

attacked that from one-third to one-half the leaves wilt, turn brown and die from this cause. After the larvae disappear from the leaves, the resemblance of these spots to some of the fungous leaf-spot maladies is so great that for one or two seasons our botanists examined the spots very carefully at intervals with the compound microscope, the only result being to strengthen the suspicion that they were in some way caused by insects. The spots are generally about three-sixteenths of an inch in diameter, but vary from mere points of brown to more than one-fourth inch in diameter, and sometimes by the coalescence of numerous spots large irregular patches of dead tissue are formed. Late in the season many of the spots break through or fall away, leaving the leaf full of holes and torn and ragged in appearance. That the larvae causing this trouble are identical with those which work in the bud seems quite certain by their similar appearance of form and coincident period of attack, but we have not yet bred leaf larvae from adults known to have developed from bud-inhabiting larvae, or vice versa, so the proof of their supposed identity is not perfect. But few larvae have been found on the leaves of old trees in the fall, the attack being apparently concentrated on the seed pods; but young trees have many larvae on their leaves in mid September, and probably until the leaves fall.

2. The most conspicuous form of injury due to the midge and the one which has been the subject of most inquiry at the Station is that done to the terminal buds. Mr. Cotton writes thus of his observations in 1905: "At several points in southwestern Ohio, injury to the tender tips of vigorously growing two-and three-year-old catalpa trees in nursery rows was observed during August and September, 1905. Usually two or three inches of the tips began to wither and turn brown, finally becoming much shrunken and black. When opened they were found to contain several small, yellow, footless maggots, similar to the catalpa pod Diplosis, and having the same power of leaping. The eggs were apparently deposited in the stem at the base of a leaf petiole or in the petiole base itself, and the stem began to die at this point."

"In one small block of two-year-old catalpas, about twenty-five percent of the trees had been injured. They had been cut back to the ground the previous spring and as a consequence had made a very vigorous growth. Many of them had been injured while still quite small, and in nearly every case all three of the lateral buds, at the last joint below the point of injury, had attempted to produce a

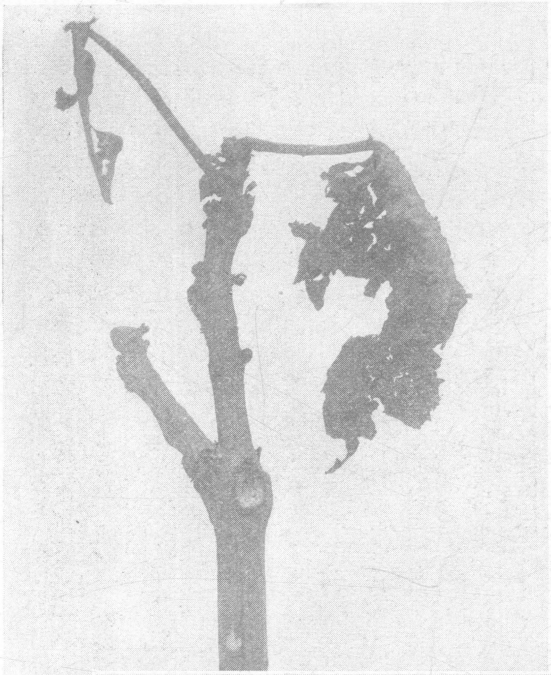

FIG. 1.

Figs. 1 and 2. Dead tips due to midge larvae working in buds and tender wood.

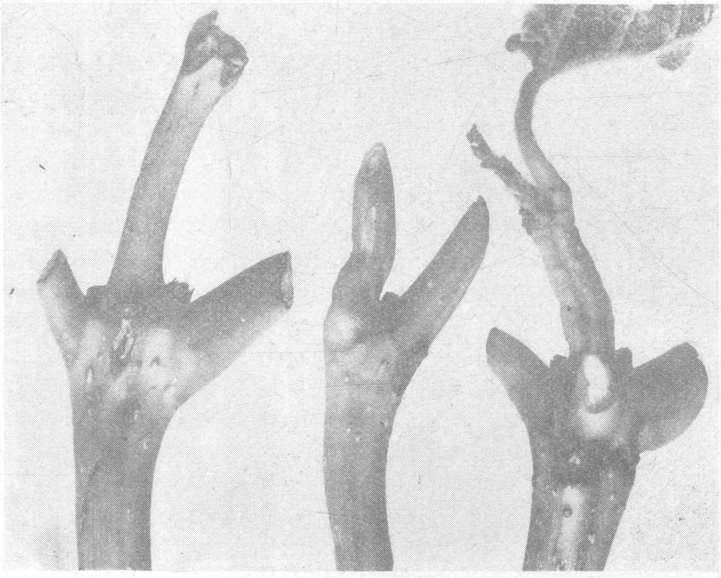

FIG. 2. *Photo by Houser.*

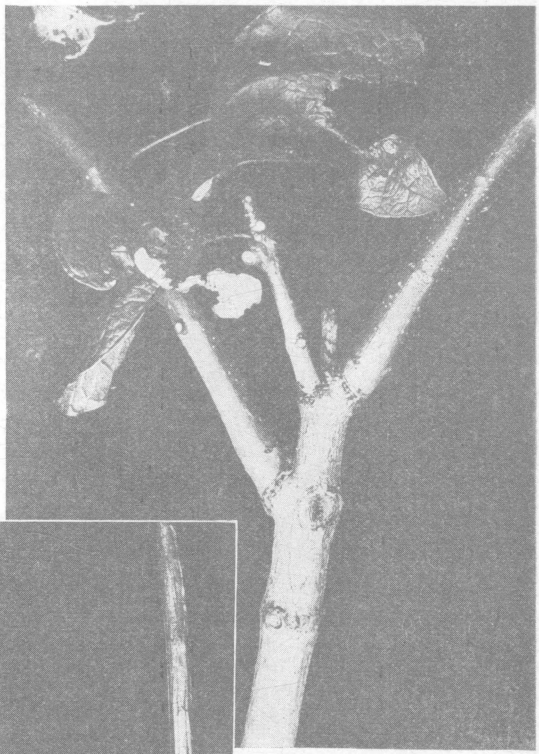

Fig. 3. Forking caused by repeated destruction of leaders.

FIG. 3.

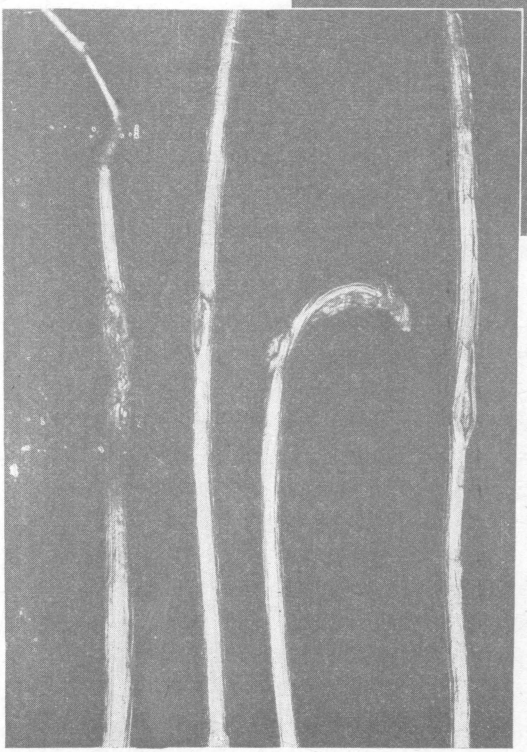

Fig. 4. Injury to seed pods.

FIG. 4. *Photo by Hoover*

leader which resulted in a crooked, forked stem. This insect seems likely to assume considerable economic importance to nurserymen and others growing catalpa trees." *

Mr. Houser in Bulletin 194 of this Station says: "During the early summer, the tender growing tips of the catalpa become swollen and in time blacken at the point of injury. During the early part of the season the injury is usually found three or four inches below the tip, and at a lesser distance during late summer when the tree is growing less rapidly. The tip above the injury dies. Following the death of the tip in early summer, the next node below develops one or more branches, and frequently a cluster of leaves, giving the tree a bushy growth. The ultimate result, after continued topping, is a stunted, crooked, forked growth."

"An examination made last spring (1906) of all the twigs upon 15 three-year-old catalpa trees, revealed the fact that 49 percent of the tips had been injured by the bud gnat."

These blackened tips are generally full of larvae, the whole presenting the same general appearance as does the interior of the pods later in the season. It seems probable that injured spots in the skin of the twigs are used as points of entrance, where these are available, but it seems certain that entrance is often gained into uninjured twigs.

In July 1907, a circular letter accompanied by a small folder of illustrations, entitled "Three Catalpa Troubles," was sent out from the Department of Entomology of the Ohio Experiment Station to several hundred catalpa growers in Ohio, requesting reports on the kinds of injury described and illustrated. Two of the forms of injury due to the catalpa midge, viz., terminal bud damage and leaf-spot were among the subjects of inquiry. Of the growers reporting, 119 had not suffered from either form of injury, so far as they were able to discover, while 107 had observed one or both forms. About one-third of these reporters (37) had noticed the terminal injury without finding any leaf-spot; 33 found leaf-spot conspicuous without any injury to the buds, while 37 found both forms of damage occuring conjointly.

3. Professor Comstock's description of the third form of damage is as follows: "In the early part of August the unripe and normally green pods of the Indian bean (*Catalpa bignonoides*) upon the Department grounds, at Washington, were noticed in many cases to have partly turned brown in a strange manner; one-half or more of the pod remaining green, while the remainder appeared to

* Bulletin 7 of Div. Nursery and Orchard Inspection, Ohio Department of Agriculture.

be drv and of the color which it usually has when ripe. Upon opening one of these abnormal pods, the mass of seeds was found to be fairly filled with active, footless, little yellow maggots, none of them more than 3.25 m.m. long. When disturbed they wriggled from the pod and fell to the ground, or bringing the two ends of the body together and suddenly straightening with a jerk, they would jump to a distance of several inches. The seeds themselves and the whole contents of the pod were, in every case, in a decaying condition. The larvae were of very different sizes, some apparently being nearly full grown, while others were evidently very young.

"Some ten days after the pods had been placed in a breeding jar, the adult flies began to appear—minute yellow midges with dusky wings. From that time on through the fall, occasional examination of the pods showed larvae of all sizes still at work, many of the pods becoming entirely brown and dry before the middle of September. It was often a puzzling thing in examining these pods to find the point where the larvae made their exit, for the pupa state is passed underground. Usually one, two or three small orifices would be found through which all the inhabitants of the pod must have issued. The manner in which this hole is made is a mystery. Examined from the inside, it shows marks of gnawings around its edge, and frequently spots are found where attempts to pierce the pod have evidently been made, but unsuccessfully. Yet as cecidomyid larvae have no horny masticating jaws, how have they then made these orifices? In pods which had evidently been attacked earlier in the season, while younger and tenderer, the holes were much larger and more abundant. Occasionally the pod will have become so dry that it will have cracked, and in such cases, of course, no other hole would be neccesary." *

On July 27th, an examination of the seed pods of the hardy catalpa, *Catalpa speciosa*, was made and injury to them by the midge was just commencing. At intervals on the pods small blackish spots were found which, when examined with a lens, were seen to be minute holes surrounded by a small area from which the skin had been eaten or torn away. Inside the bean, near the opening, a few very young midge larvae were found. Whether the gnawed surface and hole through the wall of the pod were made by the larvae or adults, it is not possible to state with certainty, but in all probability the newly hatched larvae are wholly or chiefly responsible for it. Probably in some cases they take advantage of injured places in the skin and complete openings already started by other agencies.

* Annual Report, U. S. Dept. Agr. 1880, pp. 266-267.

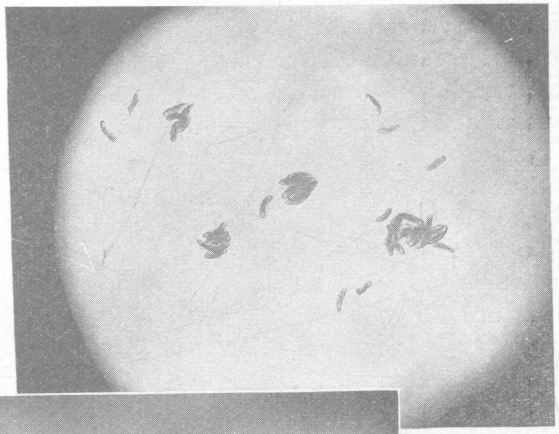

Fig. 5. Eggs of the midge much enlarged. Photo-micrograph.

FIG. 5.

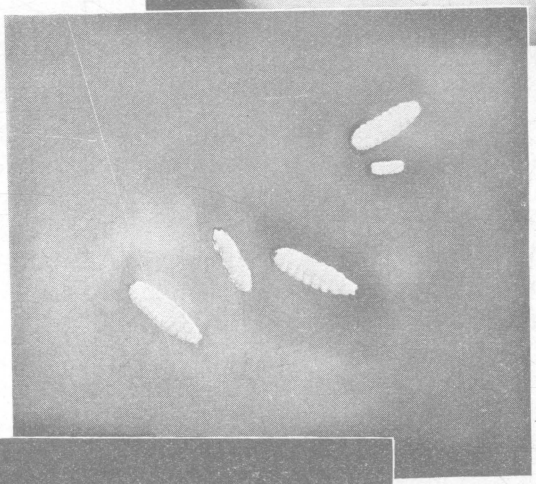

Fig. 6. Larvae of the midge much enlarged.

FIG. 6.

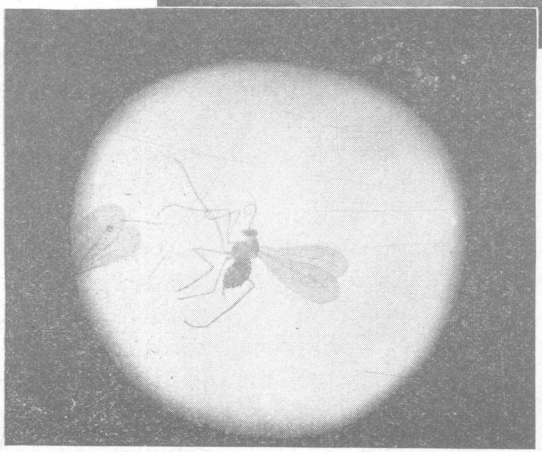

Fig. 7. Adult female midge much enlarged. Photo-micrograph.

FIG. 7.

Negatives by Goodwin.

DESCRIPTIVE.

Egg: The egg is elongate with rounded ends, being about .35 mm. long and from one-fifth to one-fourth as wide as long. It appears translucent greenish or whitish, probably depending somewhat on the degree of development reached. The eggs are laid in masses, a single mass sometimes containing upwards of 80 eggs. Many of these eggs are curved into a bow shape, and their sides adhere to each other somewhat. The masses found were laid on the inner surfaces of the tiny young leaves just formed in the terminal buds. Whether the larvae found on the older leaves come from eggs scattered promiscuously over them, or if they disperse from egg-clusters, deposited in the manner observed when the leaves are young, we do not yet know; nor do we know where the eggs are laid from which hatch the larvae found in the pods.

Larvae: The full-grown larva is about one-eighth of an inch long and about one-fifth as broad as long. The color varies from pale whitish to orange. Those working most in the open, as upon the leaves, seem, generally speaking, to be the deepest colored; yet deep colored specimens may often be found in buds and also in seed-pods. With a good magnifying glass the body is seen to be segmented transversely, a compound microscope showing fourteen segments. The larva possesses a peculiar habit. It brings the two ends of the body together and by suddenly straightening itself with a jerk, is enabled to jump several inches.

Adult: The female is a minute, two-winged fly, about one-sixteenth of an inch long and has a light yellow body and dusky wings that show a bluish iridescence under a magnifying glass.

SUMMARY OF LIFE HISTORY AND HABITS.

The adult flies must first appear in May, since the spots on the leaves appear in that month or early in June. On June 22, 1908, larvae could be found in abundance on the leaves and also in the terminal buds. Adults could be seen here and there on the leaves and could be captured in abundance by sweeping catalpas with a net. Egg-masses, freshly laid, could be found in the terminal buds. Cuttings of catalpa, containing hundreds of larvae, were sunk into moist sand and placed in breeding cages. Adult flies appeared in these cages July 4th, and for several days thereafter. It was difficult to find a mass of eggs, part of which had not hatched at the time of discovery, thus evidencing the shortness of the incubation period. As nearly as we could determine from eggs laid by midges in our cages, the young larvae begin to emerge within 24 hours or less after the eggs are laid. As nearly as could be judged from our breeding work, the life of a complete generation in mid-summer is

FIG. 8.

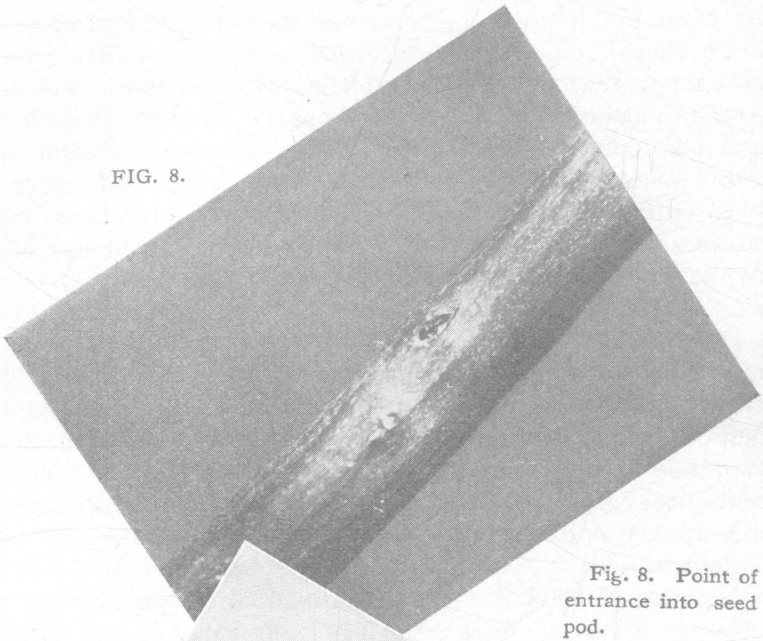

Fig. 8. Point of entrance into seed pod.

FIG. 9.

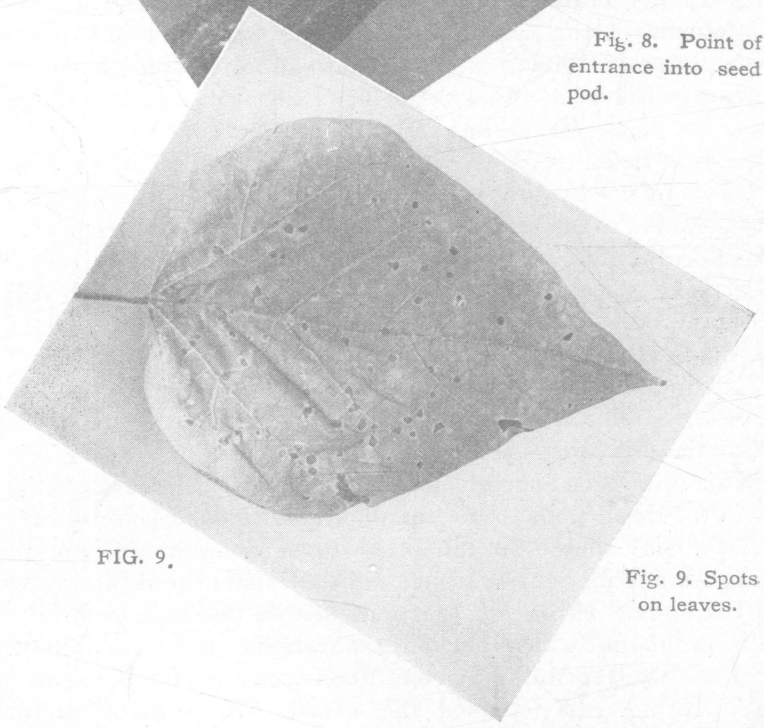

Fig. 9. Spots on leaves.

Negatives by Goodwin.

from three to four weeks. While most of the larvae descended into the sand to pupate, some did not, but transformed wherever they happened to be. Some midges were obtained in each of three glass tubes, containing nothing but cuttings harboring the larvae. The pupa, to casual observance, seemed to differ but little from the larva, except that it had become somewhat shorter. The larvae were seen to disengage themselves from the leaves by their jerking habit and drop to the ground. In the latter part of June the upper layer of earth to the depth of one-fourth to one-half inch was removed from beneath an infested catalpa tree and put into a glass covered case in the laboratory. This earth was kept spread out, the depth being not more than one-half inch, and it was moistened as often as necessary. In early July adult midges appeared in the cage, thus proving that the pupal stage is ordinarily passed in the ground. These midges were confined on catalpa slips taken from trees grown in the insectary and which had never shown signs of infestation. July 16th, three or four larvae were found on the leaves of one of these slips. No eggs or larvae could be found in the bud of this slip. A different slip, that was put into a jar containing midges that hatched from buds on July 4th, had new larvae in the bud July 15th. Some adults, that had issued some time after July 4th, were still living in the cage at the time of this observation. The average life of the fly is probably from three or four days to a week or ten days. Sometime in late June both adults and larvae disappeared from the groves outdoors and were not again found until July 16th. In the latter part of summer, the larvae seem chiefly confined to the leaves and seed pods in groves of trees that are of considerable size, but, as before recorded, Mr. Cotton observed them attacking the tender tips of growing nursery stock in August and September. Mr. Houser noted, July 30, 1906, that the "terminal borer" was more abundant than ever at Wooster. The dates at which Mr. Houser obtained midges were August 7th and 8th and September 3rd. September 12, 1908, larvae were found on leaves and adults were captured from catalpa by sweeping. Prof. Comstock obtained flies about the middle of August from larvae taken in the seed pods. We found larvae in seed pods as early as July 27th, and they still inhabited these pods in mid-September, showing a much longer life cycle than the earlier generations working in the buds. From all the evidence we possess, we infer that there is an indefinite number of generations, the rate of development probably depending on conditions of heat, moisture and food supply. In the early season the broods are probably distinctly separated, but by the latter part of July all semblance of broods

seems to be lost and after this time every stage of the insect can be found on any date before late autumn if search is made in the right place. So far as known, all varieties of catalpa cultivated in Ohio are attacked.

IDENTITY.

The specimens reared by Mr. Houser were submitted to Mr. Coquillett, of the U. S. Department of Agriculture, and to Dr. E. P. Felt, State Entomologist of New York, both specialists in diptera, and both agreed they were near *C. catalpae* Comstock, but could not be sure they were identical with it without comparing them with the original types. Abundant material, representing all stages of development, taken from both leaves and buds, was sent to Dr. Felt the past summer and after studying this he provisionally refers the insect to Comstock's species, but has not yet had access to the types for comparison. A close scrutiny of our breeding records and field observations, together with the microscopic examinations made by Messrs. Felt, Coquillett and the writer, leave scarcely a doubt that the different forms of injury herein described are due to the same species of *Cecidomyia*, though the leaf and bud maggots have not been actually bred from flies hatched from pods and then isolated. From a practical standpoint, the catalpa grower is most interested to know that the maggots causing all three forms of damage are to be dealt with in the same way.

PAST HISTORY AND LITERATURE.

This insect was first described by Prof. J. H. Comstock in the Annual Report of the U. S. Department of Agriculture for 1880. It was called the Catalpa Pod Diplosis, because the maggots were observed working in the seed pods and the adult was referred to the genus Diplosis. In 1890, Packard, in the Fifth Report of the U. S. Entomological Commission, on "Forest Insects," quoted Comstock's article in full, but added nothing thereto. In 1906, Mr. E. C. Cotton referred to it in Bulletin No. 7, of the Division of Nursery and Orchard Inspection, Ohio Department of Agriculture, and expressed the belief that it not only injured the seed of catalpa, but that it also attacked the growing tips of the branches, causing them to blacken and die back for several inches. He only inferred the identity of the insect from an examination of the maggots, being unable to rear the adults. In 1907, a circular, accompanied by a small folder of illustrations, exhibiting different phases of injury caused by the insect, was circulated among the Ohio catalpa growers by the Department of Entomology of the Ohio Experiment Station. A few notes were presented by the author at the twentieth meeting of the Association of Economic Entomologists,

these being published in Vol. I, p. 181, Journal of Economic Entomology. In Bulletin 194, p. 193, Ohio Experiment Station, Mr. J. S. Houser devotes a few paragraphs to it.

NATURAL ENEMIES.

I have observed lacewing larvae feeding with great avidity on the leaf-feeding larvae of the midge. In July, 1905, and also 1906, Mr. Houser so frequently obtained a chalcid from the damaged tips that, for awhile, we were uncertain whether it was not itself responsible for some form of damage to the branches. Subsequent observations led to the conclusion that, in all probability, it subsisted on the midge larvae, but this supposition has never been definitely proved. Mr. J. C. Crawford, of the U. S. Department of Agriculture, has described this chalcid as *Zatropis catalpae.** Adults were obtained July 14, 20, 23, 24, 25 and August 14th.

REMEDIES.

Cultivation: Young cultivated groves do not suffer so much as older uncultivated ones. The larvae fling themselves to the ground when full grown and pupate very near to the surface. The fragile adult flies cannot make their way to the surface, if plowing has buried the immature stages under several inches of earth. Plowing in late fall or early spring will accomplish most, but cultivation throughout the summer will help.

Fertilizing: Three or four pounds of kainit scattered under a tree over a circle approximating that of the spread of the limbs will in all probability destroy the larvae in the soil as well as stimulate the tree. Small trees will not need more than half this amount. It may be applied in May to prevent the first brood from issuing and if necessary can be repeated in late June to catch the large July hatching. Stir lightly into the soil with a garden rake. Sulphocarbonate of potash, applied at the rate of thirty kegs per acre, has been found effective against the pear midge in the soil by Dr. Marchal of France.

Drenching ground with insecticides: If, in early spring, the leaves, grass and trash beneath the trees are raked together from a wide circle around the trunks and burned, and these cleared circles are then drenched with kerosene emulsion diluted with eight to ten parts of water, the hibernating stages of the insect will be destroyed.

Close planting: While methods of planting probably have little or no effect on the multiplication of the midge, it seems to have a direct relation to correction of injuries caused by the midge. If the trees are planted not more than four to eight feet apart each

*Proc. Ent. Soc. Wash. Vol. IX Nos. 1-4.

way, a straight skyward growth is forced and, although the young trees start off with crooked trunks due to successive forkings, caused by terminal injury, after a few years the trunks will have become quite straight. After the trees have attained an age of five or six years alternate trees can be cut out, if necessary, and the trees may be trusted after this age to grow fairly straight.

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